Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY

Vol. XLII **1910** **No. 3**

THE TECTONIC LINES OF THE NORTHERN PART OF THE NORTH AMERICAN CORDILLERA

BY

W. JOERG

[Map facing p. 178.]

The geographic world is to be congratulated on the completion of Eduard Suess's monumental work "Das Antlitz der Erde." The final volume*, published in October, 1909, in Suess's seventy-eighth year, is a splendid proof of the undiminished vigor and freshness of this master-mind. American geographers in particular will welcome the publication of the final volume, as it contains a summary of our present knowledge of the structure of North America, the completeness of which is only made possible by the investigations and surveys which have taken place since the publication, in 1885, of the volume of Suess's work which first treated of North America.

The following sketch, together with the accompanying map, is an attempt to present in outline the structural features of the northern part of the North American Cordillera, based mainly on Suess, but in part also on Brooks's valuable geography of Alaska† and on various reports of the geologic surveys of Canada and of the United States.

THE CORDILLERA. The North American Cordillera‡ is that major geographic province of North America which occupies the Pacific side of the continent and is bounded on its outer side by the Pacific Ocean and on its inner side by the great central trough of the continent. It is preëminently a highland region and extends, from northwest to southeast, from the westernmost of the Aleutian Islands* and the mainland of Alaska to the Isthmus of Tehuantepec, at which, structurally, North America ends. The western rim of the great central trough with which the eastern border of the Cordillera is contiguous is, in its constituent parts, composed of the following sub-provinces, beginning in the north: (1) the Arctic Slope of northern Alaska, descending to the Arctic Ocean; (2) the basin of the Mackenzie River; (3) the Great Plains and, in the south, (4) the Gulf Coast, descending to the Gulf of Mexico.

---

* Das Antlitz der Erde von Eduard Suess. Dritter Band, zweite Hälfte. Wien und Leipzig, 1909. A short review will be found in Petermann's Mitteilungen, vol. 56, p. 41 (Jan. 1910).

† The Geography and Geology of Alaska...by A. H. Brooks. Prof. Paper 45, U. S. Geol. Survey, 1906.

‡ The singular form is here used, although a decision rendered on February 6, 1907, by the United States Geographic Board prescribes the plural (a reversal, however, of its previous decision), as, irrespective of its original Spanish meaning of "mountain chain," the word is intended to denote a regional *unit*.

The North American Cordillera, north of a depression passing south of the San Bernardino Mountains, between them and the San Jacinto Mountains (San Gorgonio Pass, 2,560 ft.), through the Salton Sink and along the Gila River and the Rio Grande—which limit separates from it its southern portion, Lower California and the Mexican Highland—is longitudinally divided into three zones which, named in order from the Pacific Ocean towards the interior of the continent, are: (1) the Pacific Mountain System; (2) the Central Plateau Region; (3) the Rocky Mountain System.

CONTINUATION OF ASIATIC STRUCTURE. Such are the generally recognized sub-provinces of the Cordillera. Suess, while accepting these in principle, establishes his own divisions, being guided mainly by the structural and geologic point of view, which often leads to different results than the orographic.

According to Suess, the type of structure prevailing in northeastern Asia is continued in northwestern North America. The characteristics of the peripheral arcs of Asia recur in Alaska. The tectonic lines of the "Okhotides" [Ochotiden]†, consisting of the Aldan Range (bordering, in part, the western shore of the Sea of Okhotsk), of the Lesser Khingan Range, of the Sikhota Alin, on the western shore of the Japan Sea, and of Sakhalin Island, together with the meridional range of western Yezo, furthermore, the axes of the "Anadyrides," to which belong the Verkhoyansk Arc from its northwestern end on the right bank of the delta of the Lena to its junction with the merging ends of the Aldan and

---

* Bering Island, of the Commander Islands, here so considered.

† An analogy, in English, of this rendering of the German form of the suffix is to be found in the Laurentides of the left rim of the St Lawrence valley. It has also been adopted in the English translation of Suess's work by H. B. C. Sollas. (Cf. *Bull.* Am. Geogr. Soc., vol. 41, p. 588).

Stanovoi Ranges, the Stanovoi Range itself, and, finally, the Kurile-Kamtchatka Arc—all of these tectonic lines find their counterpart in the ranges of Alaska, to which Suess has applied the name of "Alaskides." The Alaskides have, in common with the Okhotides, Anadyrides and other peripheral arcs of Asia, both the characteristic convergence of their axes and the impingement at right angles of some of these axes upon others. Thus, the Kamtchatka-Kurile Arc impinges upon the Sakhalin-Yezo Arc in the same manner as the Aleutian Arc, in its turn, upon the Kamtchatka-Kurile Arc.

But the influence of Asiatic structure is not confined to the Alaskides alone. According to Suess, this influence persists, on the western side of the Cordillera, through the St. Elias Range to its southern end at Cross Sound, and on the eastern side of the Cordillera to no less an extent than through the whole eastern front of the Rocky Mountain System to its disappearance in the southern end of the Sierra las Vegas, or Santa Fé Range, between Santa Fé and Las Vegas, N. M.

THE ALASKIDES. The constituent parts of the structural features of the Cordillera, exclusive of Lower California and the Mexican Highland, will now be considered in detail, beginning with the Alaskides in the northwest and gradually progressing to the southeast.

To the mountain ranges of Alaska Suess has applied the name of Alaskides. The Alaskides represent a virgation or radiating ramification, which diverges towards the west and converges to the east. The western portion of this radiation is drowned; its main lines are revealed by the intervening ingression of the sea, viz.: Kotzebue Sound, Norton Sound, Bristol Bay and Shelikof Strait, together with Cook Inlet. To the east the Alaskides are limited by a zone included between the 146th and 147th meridians, where they coalesce with the Pacific and Rocky Mountain Systems, as will presently appear. Three structural axes represent the main lines of this virgation. They will be named, from north to south: Romanzof* Axis (so called by Suess), Alaska Range Axis, Kenai-Kodiak Axis.

(a) ROMANZOF AXIS. The Romanzof Axis represents an arc, concave to the north, whose eastern end probably lies in about 68 1/5° N. and 147° W. near the interlocking headwaters of the Middle and East Forks of the Chandlar River with those of the

---

* After N. P. Romanzof (1754–1826), who fitted out Kotzebue's exploration expedition to the Pacific Ocean 1815–18. The name is also borne by the cape midway between the mouths of the Yukon and of the Kuskokwim and by one of the minor ranges paralleling the Romanzof Axis to the north, possibly between 142° W. and 146° W. (Cf. Brooks, Op. cit. p. 44).

Canning River, although certain other passages in Suess (iii, 2, p. 450) seem to indicate that he might also consider it to lie further to the east, possibly in 140° W. From here the arc sweeps to the west and terminates in Cape Lisburne; its continuation, Suess believes to be found in northeastern Siberia and in the New Siberian Islands with their predominating north-northwest trend.

The Romanzof Axis embraces the Endicott Range, the De Long Mountains, the Baird Mountains and the Waring Mountains.

The Endicott Range constitutes the main part of the Romanzof Axis; it may here be considered as extending from the eastern end of the latter to the interlocking headwaters of the Noatak and Kobuk Rivers.

The De Long Mountains are an outer, northern branch of the Endicott Range and terminate in Cape Lisburne, while the Baird Mountains, between the Noatak and Kobuk Rivers, and the Waring Mountains, south of the latter river, represent southern branches.

(b) ALASKA RANGE AXIS. The Alaska Range Axis begins south of the upper Tanana River at the Nabesna River and swings in a mighty curve, convex first to the north and then to the south and roughly 2,500 miles long, through the Aleutian Islands to their western end. It includes—if, in keeping with Suess's postulate with regard to the naming of mountain ranges, soon to be mentioned, we consider the Alaska Range as beginning at the Delta River—the following: Mentasta Range, Alaska Range, Chigmit Mountains, Aleutian Range, Aleutian Islands.

The Mentasta Range lies between the Nabesna and Delta Rivers and is a direct continuation on the southeast of the axis of the Alaska Range. It, in its turn, is continued to the southeast by the Nutzotin Mountains, which may be considered as ending at Kluane Lake. The Alaska Range sweeps in a bold curve, convex to the north, from the Delta River to the northern end of Lake Clark. It carries the highest summit of the continent, Mount McKinley, 20,300 ft. in elevation. Overlapping its southwestern end on the inner side lie the Chigmit Mountains*, which form a connecting link between the Alaska Range and the Aleutian Range. They seem to have the tendency to develop longitudinal valleys. The Aleutian Range forms the axis of the Alaska Peninsula and lies on its Pacific side. It extends from Cape Douglas, where its northeastern end is offset to the east with reference to the axis of the Chigmit Mountains, to Unimak Pass in the southwest. From here the chain of the Aleutian Islands extends, in its structural axis, to Bering Island of the Commander group.

---

* Brooks, *op. cit.* p. 33 and Plate VII.

(c) KENAI-KODIAK AXIS. The Kenai-Kodiak Axis is here considered to begin at the Copper River, from which it extends parallel to the Alaska Range Axis and includes the Chugach Mountains, the Kenai Mountains and Afognak and Kodiak Islands.

The Chugach Moutains enclose Prince William Sound to the north in an arc concave to the north; the transverse depression of Turnagain Arm and of an east-west fiord of Port Wells, which confine the Kenai Peninsula at its neck, may be considered their southwestern limit. From here the Kenai Mountains, lying on the oceanic side of Kenai Peninsula and forming its backbone, trend to the southwest and find their continuation in Afognak and Kodiak Islands with an offset to the east similar to that which the Aleutian Range undergoes with reference to the Chigmit Mountains.*

INTERVIRGATIONAL STRUCTURE. The Seward Peninsula probably also represents a branch of the virgation† and undoubtedly constitutes a connecting link, structurally, between North America and Asia. But evident as is this connection in the general relationship, yet it is difficult directly to determine the same between the Seward Peninsula and the Chuckchee Peninsula of Siberia, of which the former is doubtless a continuation. This difficulty lies in the fact that the Seward Peninsula is less a region of well-marked tectonic lines than one of local intrusions of various geologic periods.

The Yukon Hills, south of the Koyukuk River, the Gold Mountains, between the Melozi and Yukon Rivers, and the Kaiyuh Mountains, paralleling the Yukon on the left along its south-southwestern course may be considered as minor ramifications of the virgation, included between its major axes.

The Kuskokwim Mountains, of plateau-like character and with a general southwestern trend, possibly crossed by the Kuskokwim River in 62° N., together with their southern continuation, the Ahklun Mountains, terminating in Cape Newenham, Suess does not consider as a branch of the virgation; they are an extraneous element.

COALESCENCE OF THE ALASKIDES. To the east the Alaskides are limited by their coalescence [Scharung]‡ with the ranges of the Pacific and Rocky Mountain Systems. This coalescence takes place in a zone extending northward from Prince William Sound, between 146° W. and 147° W. to the Arctic Ocean. To this coalescence, Suess has given the name of Coalescence of Chugach* after the Innuit appellation of Prince William Sound, a form still retained in the name of the Chugach Mountains. To the west of this coalescence the general trend of the mountain axes is southwest, gradually changing to west-southwest and finally west-northwest in the northern (Romanzof) branch of the Alaskides; to the east of the coalescence the general trend is southeast. All of the important ranges of the interior are to a certain extent subjected to this influence, which is most conspicuous on the coast of the Pacific Ocean, where the tectonic lines meet nearly at right angles, enclosing the Gulf of Alaska.

---

* Caused by a zone of fracture of northwest strike from Kamishak Bay to the passage between Afognak Island and Kenai Peninsula? W. J.

† Cf. varying statements in Suess III, 2, p. 395 and p. 426.

‡ Rendered by "syntaxis" in the translation by H. B. C. Sollas.

The Alaskides coalesce in their southern branch, the Kodiak-Kenai Axis, with the Pacific Mountain System to the north of Prince William Sound where, as the Chugach Mountains, they imperceptibly merge into the St. Elias Range.

With the Rocky Mountain System the Alaskides coalesce in their central and northern branches, the Alaska Range Axis and the Romanzof Axis, respectively. The Alaska Range does not directly merge with the main axis of the Rocky Mountain System, as is the case in the southern coalescence, but their two respective ends overlap. The Alaska Range with its southeastern continuation, the Mentasta and Nutzotin Mountains, comes into lateral contact with the northwestern end of the main axis of the Rocky Mountain System, which terminates in 147° W. between the small Chena River and the Tanana River, the latter forming the division between the two axes.

The coalescence of the northern branch of the Alaskides, the Romanzof Axis, with the eastern axes of the Rocky Mountain System is considered to take place either in 147° W. or 140° W., according to which view is entertained with regard to its eastern end, as referred to above.

According to Suess it seems probable that a fault zone separates the Mentasta Range from the Nutzotin Mountains and another the Chugach from the Kenai Mountains, the former with a northwest-southeast strike, the latter with a northwest-southwest strike, reflecting the trend of the axes on both sides of the zone of coalescence.

ALASKIDES A TECTONIC UNIT. To Suess, the Alaskides represent a tectonic unit. Every coalescence exhibits the result of two opposing dynamic influences. Therefore, it should be considered a boundary, and, accordingly, the name of no mountain range should be extended beyond it. Thus, for the Alaskides, Suess cannot accept Brooks's tripartition into Pacific Mountain System, Central Plateau Region and Rocky Mountain System. He nevertheless recognizes the great similarity of axial structure on both sides of the zone of coalescence, and he appreciates the factors that have led to the extension into Alaska of the subdivisions of the Cordillera in the United States and Canada. Indeed, his assumption of the persistence of Asiatic structure in the Rocky Mountains involves the recognition of this similarity, which is visible in the analogy of arrangement and of direction of folding between the respective outer and inner axes of the Alaskides and of the ranges to the southeast of the zone of coalescence. On the one hand, namely, the outer arcs of the Alaskides (Kodiak-Kenai and Alaska Range Axes) are concave to and face the Pacific Ocean, the direction of folding being toward it, while, on the other, the inner arc (Romanzof Axis) is concave to and faces the Arctic Ocean, being folded towards the north; both find their counterparts in the St. Elias Range, which faces the Pacific and is folded toward it, and in the eastern ranges of the Rocky Mountain System, which face towards the interior of the continent and are folded toward the east.

---

* "Tschugatsk" in the original.

ST. ELIAS RANGE. The St. Elias Range, which does not belong to the Alaskides but lies to the east of the zone of coalescence, extends from the Copper River to Cross Sound. It forms a high, rugged coastal barrier, attaining extreme elevations in its culminating peaks (Mount Logan 19,500 ft., Mount St. Elias 18,024 ft., Mount Fairweather 15,387 ft.). Between its base and the coast lies a shelving coastal plain, at times 20 to 30 miles wide and in many places covered by huge glaciers.

PROVISIONAL CHARACTER OF NOMENCLATURE. The terminating limits of mountain ranges and axes, as given in the above, should, of course, be merely considered as tentative. Even Suess's statements do not always allow of a definite conception of the extent of the various ranges, a fact which is quite comprehensible in view of the conflicting condition of the nomenclature of the region under consideration, due on the whole to—at least for such purposes—inadequate knowledge concerning the objects to be named. This at times leads even to a divergence of conception in the works of the same author, as expressed in the text or on the accompanying maps. Furthermore, even ample knowledge of a mountain region does not always insure an indisputable delimitation of its component parts, as witness the problem of the boundary between the Alps and the Appennines, still awaiting a solution satisfactory to all.

THE "INTER-MOUNTAINS." All of the ranges to the west of the zone of coalescence belong to Suess's system of the Alaskides. To the southeast of this zone and enclosed between the St. Elias Range on its western and the Rocky Mountain System on its eastern side lies the beginning of one of the nine major structural provinces* into which Suess has divided the "face of the earth"—a province to which he gives the name "das Zwischengebirge," here provisionally rendered by "the Inter-Mountains." It extends obliquely through the whole Cordillera from its Pacific to its Atlantic side, *viz.:* from the zone of coalescence to the Sierra Madre del Sur, on the southern rim of the Mexican Highland, through approximately forty-three degrees of latitude. It is bounded on the west by the St. Elias Range, the "Vancouver Axis" mentioned below, the Coast Ranges of the Pacific Coast of the United States (which represent the beginning of Andine structure), Lower California, the Sierra Madre del Sur; on the east by the Rocky Mountain System, where, in the south, the outer scarp-rim of the Wasatch Mountains and the Colorado Plateau form its eastern boundary. It includes the Wrangell Mountains, the Skolai Mountains, the Alexander Archipelago, the Coast Range and the Interior Plateaus of British Columbia, the Cascade Mountains, the Sierra Nevada, the granitic areas of Oregon and Idaho, the ranges of the Great Basin and the Mexican Highland, as which it reaches the Gulf of Mexico. It is therefore amply evident that it does not coincide with any of the recognized subdivisions of the Cordillera; it includes portions of the Pacific Mountain System, the greater part of the Central Plateau Region and even parts of the Rocky Mountain System, as will appear. The principles underlying its delimitation are structural and geologic, not orographic or topographic. Its structural relation to the other provinces cannot be dwelt upon here. As a unit it is characterized by pre-Carboniferous formations, by old intrusive rocks, by folding and faulting and by recent vulcanism.

CONSTITUENT PARTS OF THE INTER-MOUNTAINS. The Wrangell Mountains are a well-defined group of, in part, still active volcanic mountains of roughly elliptical shape, 100 miles long and 70 miles broad, and with west-northwest and east-southeast trend. On the northeast they are separated from the Mentasta Range and the

---

* Suess, III, 2, pp. 573 seq.

Nutzotin Mountains by a well-marked depression continuing the upper valley of the Copper River across the transverse valleys of the Nabesna and Chisana. To the northwest and southwest they are enclosed by the bend of the Copper River, the lower part of which is continued to the southeast by the Chitina River.

Mesozoic rocks, which form the southern base of the Wrangell Mountains, chiefly compose the Talkeel Mountains,* a group with southwestern trend that lies between the Matanuška River on the south and the upper Sushitna on the north. As the Aleutian Range on its Pacific side also consists of Mesozoic rocks, the Talkeel Mountains, geologically at least, may be considered as a connecting link between the Wrangell Mountains and the Aleutian Range.

Between the Alaska Range and Mentasta Range on the north, the Wrangell Mountains on the east, the Chugach Mountains on the south, the Talkeel Mountains on the west, lies the Copper River Plateau, an extensive level tract of about 2,200 ft. mean elevation.

To the southeast the Wrangell Mountains are continued by the Skolai Mountains which trend southeast and merge with the St. Elias Range. The Skolai Mountains afford a typical example of the still prevailing conflicting nomenclature. Brooks would seem to consider them as lying to the south of the Nutzotin Mountains, between these and the Wrangell Mountains, and forming a connecting link between the eastern continuation of the Alaska Range and the St. Elias Range† and so indicates them on Plate VII, while R. U. Goode's map of Alaska‡ accompanying the same report interprets them in the above sense as a southeastern continuation of the Wrangell Mountains, in concurrency with Suess.

Eruptive rocks occur in the greater part of the Alaska Range Axis from the Aleutian Islands through the northwestern longitudinal half of the Alentian Range to the Chigmit Mountains and embrace furthermore the main massif of the Wrangell Mountains. In fact, the Wrangell Mountains, although not geographically connected, may be considered a northeastern continuation of the volcanoes of the Aleutian chain. According to Suess, this is the only known case of a coalescence being accompanied by a line of active volcanoes (Wrangell Mountains).

In their northwestern part, the Inter-Mountains comprise the

---

* Cf. Brooks, *op. cit.* Plate XXI.

† Brooks, *op. cit.* pp. 29, 31, 32, 34, 35, 36, 255.

‡ Map of Alaska compiled under the direction of R. U. Goode by E. C. Barnard and others. 1:2,500,000. contours; interval 1,000 ft. The excellent reduction to 1:5,000,000 with much additional information, relief in shading and lowland below 1,000 ft., in green tint, published as Plate I, *Petermann's Mitteilungen*, 1907, should also be consulted.

Alexander Archipelago. Here occur large areas of massive igneous rocks, chiefly of effusive origin,* which may be considered as extensions from the main body of the batholith.

The Inter-Mountains further comprise an intrusive batholith of great length to which Suess has given the name of [British] Columbian Granodiorite. It extends through fourteen degrees of latitude from 63° N. to just south of the boundary between Canada and the United States. It is practically coextensive with the Coast Range of British Columbia and embraces the entire area, colored to indicate "coast granite" on the "Western Sheet of the Geological Map of the Dominion of Canada" (scale 1:3,171,000), published by the Geological Survey of Canada, with the exception of a narrow zone of sedimentary rocks which occupy the coast from the head of Lynn Canal to Dixon Entrance.† It extends in a belt increasing in width from 30 miles at 141° W. to 100 miles in the south, from the northern front of the Nutzotin Mountains, across the Naberna and the upper White River, past Lakes Kluane and Dezadeash, paralleling the coast as far as the bend of the lower Fraser. Here the batholith retreats from the coast and dwindles to a narrow end, which projects to the south of the Canada-United States boundary and forms the nucleus of the Skagit Mountains, which lie to the west of the upper Skagit River, being crossed by its middle course, and constitute a subdivision of the northern end of the Cascade Mountains.

Here, superimposed on the granite, begins, with Mt. Baker, the meridional line of andesitic volcanoes of the Cascades which extend nine degrees to the south and include Lassen Peak. South of Lassen Peak the Cascade Mountains are continued by the Sierra Nevada. Both the Cascade Mountains and the Sierra Nevada form a part of the Inter-Mountains.

To these also belong Dawson's Interior Plateau of British Columbia.‡ It lies between the Coast Range and the Rocky Mountain System and extends, with a length of 500 miles and an average width of about 100 miles, from Babine Lake southeast to just south of the Canada-United States boundary in the Okanagan Valley. In early Tertiary time it had been base-leveled to a peneplain. This peneplain "has never since been entirely obliterated, although . . . it has been an area of deposition of strata and the theatre of great volcanic eruptions."* According to Suess, this Tertiary peneplane lies horizontally over the north-northwest trending and folded rocks of the Inter-Mountains.

---

* Brooks, *op. cit.*, p. 226.

† Cf. Brooks, Plate XXI.

‡ Cf. *inter alia.* Annual Report Geol. Surv. Canada, vol. VII (new series), 1894, pp. 4–9 B.

The eastern boundary of the Interior Plateau, as far as determined, may be taken with Daly† to follow in its salient features the Quesnel River, Adams Lake and the Kettle River. To the east of it lie the orographic units established by Daly which, according to the definition of the Rocky Mountain System here entertained, belong to this major subdivision of the Cordillera. Suess, however, includes in the Inter-Mountains the western half of Daly's Columbia System, the unit lying immediately to the east of the Interior Plateau, so that here their eastern boundary lies approximately along the western base of the Gold Range, a subdivision of the Columbia System and, possibly, along the North Fork of the Kettle River and Christina Lake (118 1/5° W.). This important tectonic boundary between the Rocky Mountain System and the Inter-Mountains is marked by no structural feature of note; no fault line separates the two divisions.

In the south the Inter-Mountains are represented by the granite area of Oregon and that of Idaho. To the former belong the Blue Mountains which, although separated from it by the basalt through which the Snake River has eroded its canyon, are technically continuous with the granite mass of Idaho. The latter, a post-Triassic intrusive batholith of a width, at times, of 100 miles, includes in the north the meridional section of the Bitterroot Mountains south of Lolo Pass, which separates the granite from the Algonkian sedimentary terrane of Lindgren's "Cœur d'Alene Mountains"‡ to the northwest. On the east, this part of the batholith is bounded by the fault of the Bitterroot Valley, which, according to Suess, separates it from the Rocky Mountain System. A division based on orographic principles, however, would place the western limit of the latter farther to the west, at the eastern edge of the Columbia Lava Plain and the Snake River Basalt, thus including the Bitterroot Mountains, while the Bitterroot Valley, from the point of view of this classification, represents merely a boundary between subdivisions. In the south the eastern edge of the batholith extends as far as Hailey (114¼° W.; 43½° N.); its southern front continues west-southwest and includes the Owyhee Mountains.

---

* Ibid., p. 5, B.

† R. A. Daly: The Nomenclature of the North American Cordillera between the 47th and 53rd Parallels of Latitude. *Geogr. Journ.*, vol. 27 (1906, 1), pp. 586–606. Map, p. 588.

‡ W. Lindgren: A Geological Reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho. U. S. Geol. Surv., Prof. Paper 27, 1904.

These various subdivisions of the Inter-Mountains, viz.: the Cascades, the Blue Mountains, the granite batholith of Idaho, although isolated, are structurally one, their connecting parts having been overflowed and obscured by the Miocene lava flows which created the Columbia Lava Plain and the Snake River Basalt.

WESTERN BOUNDARY OF INTER-MOUNTAINS. To the west the Inter-Mountains are, it will be remembered, bounded by the St. Elias Range, the "Vancouver Axis," the Coast Ranges, Lower California and the Sierra Madre del Sur. The St. Elias Range has been previously referred to, while the two last mentioned parts of the western boundary of the Inter-Mountains are not included in the scope of the present discussion.

The "Vancouver Axis" embraces the Queen Charlotte Islands and Vancouver Island. According to Suess, they are not a continuation of the Alexander Archipelago, but an independent mountain system similar to the Inter-Mountains and lying to the west of them.*

The Coast Ranges of the Pacific Coast of the United States—which should, of course, not be confused with the Coast Range of British Columbia from which they are entirely distinct—are characterized by an *échelon* alignment of their axes, which is typical of the structure of the Pacific Coast, beginning with the Queen Charlotte group and extending far to the south.

INTER-MOUNTAINS NOT A GEOGRAPHIC PROVINCE. Such, then, is the extent of the Inter-Mountains. In conclusion it may be stated that, as justifiable as is their establishment as a unit from the structural point of view, yet a division, based on geographic principles, cannot recognize them as a natural province. The above considerations as to their nature and extent do not, therefore, modify the system of subdivisions of the Cordillera suggested at the beginning of this paper.

ROCKY MOUNTAIN SYSTEM. There remains to be discussed a major subdivision of the Cordillera, the Rocky Mountain System. According to Suess its northern end is marked by its coalescence with the Alaskides; in the south it has previously been defined as extending to the Rio Grande. Whether, however, the mountain ranges of the region, enclosed by the Pecos and the Rio Grande, above its confluence with the former, should not be excluded from the Rocky Mountain System because of the similarity of their habitus to that of the ranges of the adjoining portion of the Mexican

---

* III, 2, p. 466. Cf., however, conflicting statement on p. 467.

Highland will, in the present paper, be left an open question. Suess inclines to this view* and considers this region as a spur of the Inter-Mountains. Powell, on his map of the physical divisions of the United States,† also classifies as a separate province the "Pecos Plateaus," which embrace a part of the region under consideration, while Davis‡ includes it in the equivalent of the Rocky Mountain System.

On the east, the Rocky Mountain System is bounded by the great central trough of the continent in its contiguous parts, the Mackenzie Basin and the Great Plains, as before stated. On the west it is bounded by the Central Plateau Region. The eastern limit of the latter, which coincides with the eastern limits of its subdivisions, will evidently be the western boundary of the Rocky Mountain System. This boundary has before been roughly indicated with respect to its northern and central subdivisions, the Interior Plateau of British Columbia and the Columbia Plateaus (as the central subdivision will here be termed, in keeping with Powell's and Davis's classification;§ it includes, therefore, the Columbia Lava Plain, Snake River Basalt and the greater part of Suess's granitic mass of Idaho). The question as to the eastern boundary of the southern subdivisions of the Central Plateau Region must also, for the time being, be left unanswered. Some of the points to be decided in this connection may, however, be indicated. They are, whether, on the one hand, the Wasatch Mountains (which undoubtedly form the eastern boundary of the Great Basin), together with the region which lies between them and the Rocky Mountains of Colorado and south of the Uinta Mountains—the drainage basin of the lower Green and Grand Rivers and of the upper Colorado—and, on the other, the Colorado Plateau, should both be considered as belonging either to the Central Plateau Region or to the Rocky Mountain System. If the basin of the lower Green and Grand Rivers, the Colorado Plateau and the region between the Rio Grande and the Pecos, be not counted in the Rocky Mountain System, then, in its southern portion, it would be bounded on the west by the western base of the Rocky Mountains of Colorado and on the south by the upper San Juan River and the Rio Chama, and would finally come to a tapering end in 35° 30′ N. as the Santa Fé Range, previously referred to.

---

* III, 2, p. 491.

† J. W. Powell: Physiographic Regions of the United States. National Geographic Monographs. Vol. I, No. 3 (pp. 65–100), 1895. Map on pp. 98–99.

‡ The International Geography, edited by H. R. Mill, 1909. Map p. 719.

§ Maps of *Op. cit.*

CONTACT WITH PACIFIC MOUNTAIN SYSTEM. To the north of the east-west course of the Columbia River in 48° N. the Rocky Mountain System and the Pacific Mountain System come into contact for about one degree of latitude, thus separating the Central Plateau Region into two halves, the Interior Plateau of British Columbia lying to the north, the Columbia Plateaus to the south of the zone of contact. Probably the Okanagan Valley below Osoyoos Lake (49° N.) represents the boundary between the two systems.

CHARACTERISTICS. The general trend of the ranges of the Rocky Mountain System is southeast—varying at times to south-southeast—from its coalescence with the Alaskides in the north to about 42° N. where the Laramie Range bends to the south. From this point southward the Rocky Mountain System, as a unit, assumes a meridional trend.

A characteristic of the ranges composing the Rocky Mountain System, which persists throughout its entire extent, is their alignment *en échelon,* i. e., the arrangement of a series of roughly parallel ranges in such a manner that the end of one projects beyond the end of the next, so that their front presents a step-like ground plan. This arrangement is particularly evident in the eastern front of the system, especially in the portion with meridional trend. Here the north-south axes have the tendency to bend to the north-northwest at their northern ends and to form a virgation. Their main trunks, however, with their north-south trend, preserve the straight front of the whole system towards the Plains. But, due to their *échelon* character, this continuity of their front is interrupted by reentrant angles at every merging of the southern end of one range with the northern end of the next. Suess here distinguishes four axes which are aligned *en échelon* to each other: (1) the Laramie Range; (2) the Medicine Bow Range and the Front Range; (3) the Park Range, the South Park Range and the Wet Mountains; (4) the Sawatch Range, the Saugre de Cristo Range, the Culebra Range and the Santa Fé Range.

Arrangement *en échelon* is also evident on the western side of the Rocky Mountain System. The ranges lying between the basin of the upper Green River and the Snake River Basalt show the same tendency as those of the eastern front to bend towards the northwest, at the northern end of their meridional axes, until they disappear under the basalt floods of the Snake River basin.

TWO LONGITUDINAL BELTS. The Rocky Mountain System, in its northern portion, may be considered to consist roughly of two longitudinal belts, an inner (with reference to its relative position in the Cordillera) or western and an outer or eastern one.

It is to the outer belt that the name "Rocky Mountains" has always unreservedly been given. It is only with growing recognition of the fact that the Rocky Mountains are merely a part of a larger system that their name, in the form of "Rocky Mountain System,"* has been extended to include the whole system. And this is only just, inasmuch as the part with which a definite conception was first associated—because of the westward movement of exploration and settlement and, in part, because of the well-defined character of, at least, its eastern boundary—should give its name to the whole, after it has once been recognized as a part of that whole. On the other hand it does not seem conducive of greater clarity of conception to withhold the name of Rocky Mountain System from the whole mountainous belt lying between the Interior Plateau of British Columbia and the Great Plains, as some Canadian geologists do, especially as the terms they are constrained to resort to, such as "the Rocky Mountains proper" or "the main range of the Rocky Mountains," for what is here designated the Rocky Mountains (the eastern belt) seem to indicate a feeling that the name is associated with a larger conception than that corresponding to the outer belt alone.

The boundary between the inner and outer belts of the Rocky Mountain System, as far as determined, is represented by a remarkable longitudinal depression which extends for over 800 miles from the head of the Liard River to Flathead Lake, Montana. The streams flowing in it drain it, in general, alternately in opposite directions, indicating the absence of a continuous gradient. They are, from north to south: Kachika River (flowing N.W.), Tochieca River and its trunk stream, Finlay River (both S.E.), Parsnip River (N.W.), upper Fraser River (N.W.), Canoe River (S.E.), upper Columbia River (N.W.), upper Kootenay River (S.E.), lower Tobacco River (N.W.) and Stillwater River (S.E.), which flows into the Flathead River, a short distance above its emptying into Flathead Lake. The continuation of this trough to the south may possibly be found in the depression accompanying the western foot of the Mission Range and in the Bitterroot Valley. To this dominant feature Daly has felicitously given the name of "Rocky Mountain Trench."* As to its structural significance, Suess is not willing to decide; the only at all comparable phenomenon is that of the "Scandinavian Line."†

---

* Daly uses this term (*Op. cit.*, p. 592 and p. 604) to designate what is here called the outer or eastern belt. It may be added that he wishes the term "Pacific Mountain System," if at all used, applied as a variant for the Cordillera because of its being pre-eminently "a Pacific feature of the globe" (pp. 591 and 592). Davis uses "Rocky Mountain System" in the sense in which "the Cordillera" is here used (*Op. cit.*. p. 671) and designates by "Rocky Mountains" (Map p. 719) the equivalent of "Rocky Mountain System" in the present paper.

WESTERN BELT NORTH OF 52° N. The axis of the inner or western belt of the Rocky Mountain System begins between the Chena and Tanana Rivers in 64½° N. and 147° W. and extends in an east-southeastern direction that gradually changes to southeast across the meridional course of the Yukon above the Klondike River, then, crossing obliquely the lower courses of the Stewart and Pelly Rivers, continues as the Cassiar Mountains across the Dease River, an affluent of the Liard, forms the backbone of the mountains lying to the west of the Finlay and Parsnip Rivers and, as the Cariboo Range, reaches the bend of the Columbia River in 52° N., where the Rocky Mountain System expands into a virgation to the south.

EASTERN BELT NORTH OF 52° N. The main axis of the outer or eastern belt of the Rocky Mountain System may be considered as beginning on the eastern side of the Yukon, between the Klondike and Tatonduk Rivers. From here to the interlocking headwaters of the Stewart and Gravel Rivers it is known as the Ogilvie Range.‡ It has an east-southeast trend. Continuing it on the east and extending to the southeast to an unknown distance lies the Selwyn Range.§ The Ogilvie and Selwyn Ranges carry the Yukon-Mackenzie watershed.

The Tanana Hills north of the lower Tanana (Suess's Ketchumstock Mountains?‖ may possibly be a western continuation of the Ogilvie Range. In this case they would represent the westernmost extension of the Rocky Mountain System.

Towards the Mackenzie the Ogilvie and Selwyn Ranges are limited by a scarp-like front which rises abruptly from the plateau below. This, together with the fact that the front is in part formed by the outermost of the sub-ranges trending parallel to the main range, has led to their being taken for the continuation of the main range of the Rocky Mountains. The average elevation of

---

* *Op. cit.* p. 596.

† The eastern boundary of the gneiss area of southwestern Sweden, extending through five degrees of latitude from the coast in 15° 20′ E. past the southern end of Lake Wetter, along the eastern shore of Lake Wener and up the Klar-Elv. Cf. III 1, p. 479.

‡ Cf. J. Keele: Upper Stewart River (Report C) and C. Camsell: Peel and Wind Rivers (Report CC), *Annual Report* Geol. Surv. Canada, vol. XVI (new series), 1904.

§ R. G. McConnell: The Macmillan River. *Annual Report* Geol. Survey Canada, vol. XV (new series), 1902–93, p. 26A, and J. Keele's report.

‖ III, 2, p. 453.

2,000 to 3,000 feet for these frontal sub-ranges, as compared to that of 7,000 to 8,000 feet for the Ogilvie and Selwyn Ranges, should afford a criterion for their relative valuation. The Selwyn and Ogilvie Ranges are here considered the continuation of the Rocky Mountains or outer belt of the Rocky Mountain System. On the accompanying map, therefore, the lines bounding the Mackenzie Basin on the west should be interpreted as the limit of the mountainous region of which the Ogilvie and Selwyn Ranges represent the axes, and not as mountain axes themselves.

In 136° W. this scarp-like front, which, to the east of this point has an east-southeastern trend, suddenly swings due north and meets the delta of the Mackenzie, enclosing a large semicircular tract of a mean elevation of 1,700 feet, termed the Peel Plateau, and drained by the river of that name. On its approach to the Arctic Ocean the scarp-front bends to the northwest and then to the west, assuming the trend dictated by the coalescence. The scarp is here known as the Richardson, Buckland and Franklin Mountains. They probably bear to the Romanzof Axis the same relation as the scarp of the Mackenzie Basin to the Ogilvie and Selwyn Ranges. According to Suess, they represent the northernmost ranges with which the Rocky Mountain System coalesces with the Alaskides.

The heights accompanying the right bank of the Mackenzie and extending from its bend in 62° N. to its bend in 66° N. may also be considered as sub-ranges or outliers of the Rocky Mountain System.

To the south of the Liard River, where the mountains are again marshalled into a solid phalanx, the main axis of the outer belt, or Rocky Mountains, extends to the southeast across the upper Peace River, and the depression occupied by the headwaters of the Fraser and Athabaska Rivers, connected by Yellowhead Pass.

WESTERN BELT SOUTH OF 52° N. South of this region and the bend of the Columbia River, the Rocky Mountain System expands into a greater number of diverging ranges. In the inner belt, the Gold Range, with its continuation, the Colville Mountains, and the Selkirk Range, with its minor offshoots, the Slocan Mountains* and the Pend Oreille Mountains, about on the Columbia Lava Plain. Between the Selkirk Range and the Rocky Mountain Trench lies the Purcell Range. To the south these are continued on one side of Clarks Fork by the Bitterroot Mountains, on the other by the Cabinet and Flathead Mountains. Confusion prevails with regard to the limits of the Bitterroot Mountains. The United States Geographic Board* includes under this term the entire range whose crest forms the boundary between Idaho and Montana, from Pend Oreille Lake to the crossing of the Oregon Short Line near 112° W. Lindgren† wishes the name restricted to the section between Lolo and Nez Percé Passes, while R. U. Goode‡ applied the name to the section between Pend Oreille Lake and South Pass, slightly farther south than Nez Percé Pass and at the head of the Bitterroot River.

---

* Daly, *Op. cit.* p. 602 and Map p. 588.

EASTERN BELT SOUTH 52° N. The outer or eastern belt of the Rocky Mountain System, south of the bend of the Columbia, is continued by the "Canadian Rockies" proper, by the Livingston and Lewis Ranges and the ranges accompanying them on the west: the Galton Range, the Swan Range and the Mission Range, the meridional axis of the latter forming an angle with the prevailing south-southeastern trend.

South of the bend of the Missouri River, and extending to the plateau of Yellowstone Park, the ranges of the outer belt undergo a decided change in character. Instead of the prevalence of long ranges of the folded type, aligned *en échelon,* which obtain to the north and south, this region is structurally distinguished by the presence of faults and dislocations which have created mountains of the block type. To this structural category belong the Big Belt Mountains, the Little Belt Mountains, with their continuation, the Big Snowy Mountains, the Bridger Range, the Snow Mountains, the Beartooth Mountains.

ROCKY MOUNTAIN SYSTEM SOUTH OF 47° N. To the west of this zone lies the granitic mass between Helena and Butte, the mountains lying on the western side of Deerlodge Creek and those bounding the Bitterroot Valley on the east. To the south lie the Jefferson Range, continuing the Helena-Butte mass, the Madison Range and the Gallatin Range, continuing the Bridger Range.

On the west the plateau of Yellowstone Park is bounded by the Teton Range, which meets the ranges already referred to as bordering the Snake River Basalt *en échelon* to the east and forming a connection with the Wasatch Mountains, while on the east it is bordered by the Absaroka Range, which, with its continuation, the Owl Mountains, bounds on the west and south the Bighorn Basin, of which the Bighorn Mountains form the eastern rim.

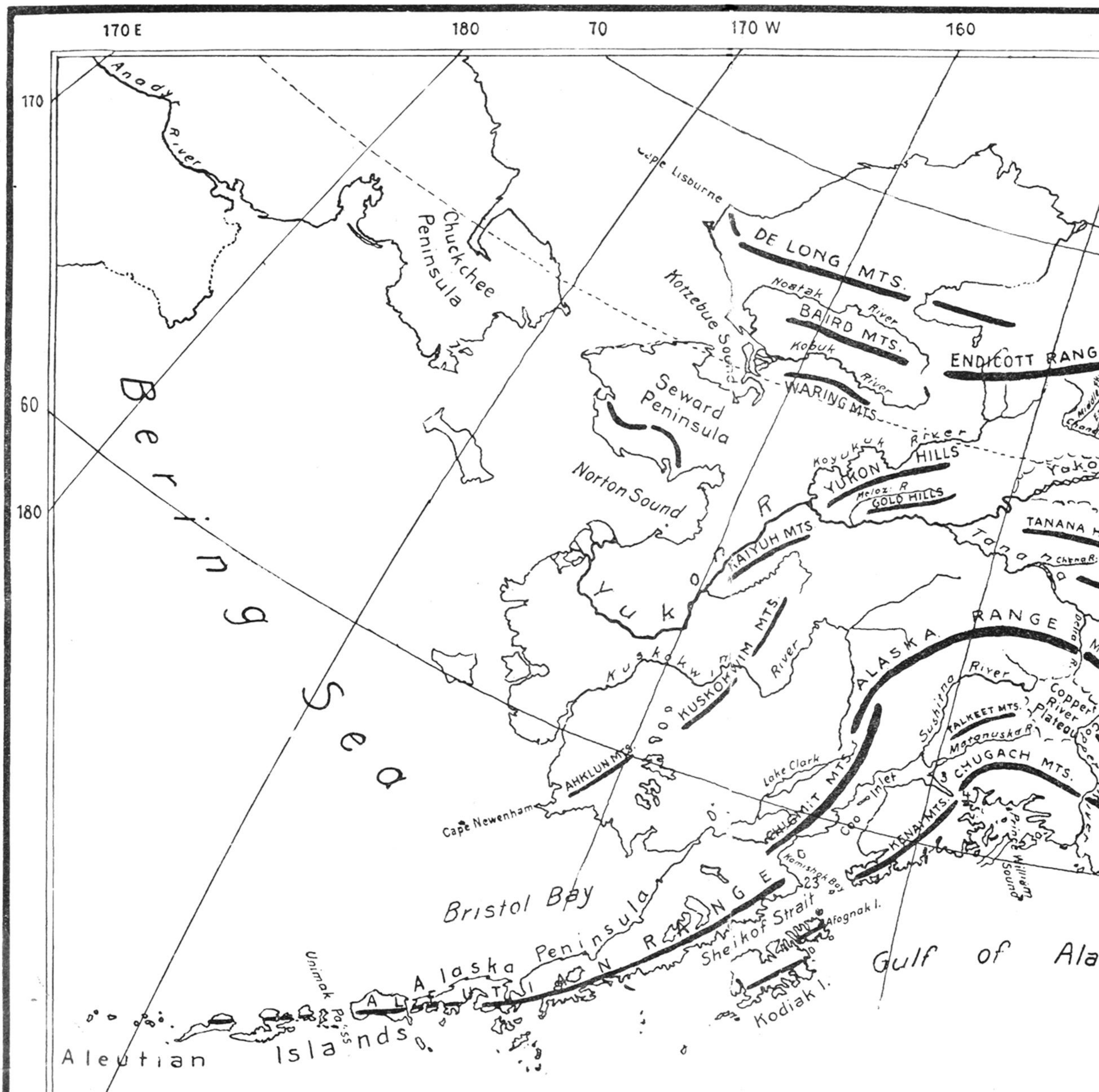
Beginning with the Gros Ventre Range on the eastern side of the Snake River, just below its issue from Jackson Lake, the axis of the

---

* As "Bitterroot Range," decision of Feb. 6, 1907.

† *Op. cit.*

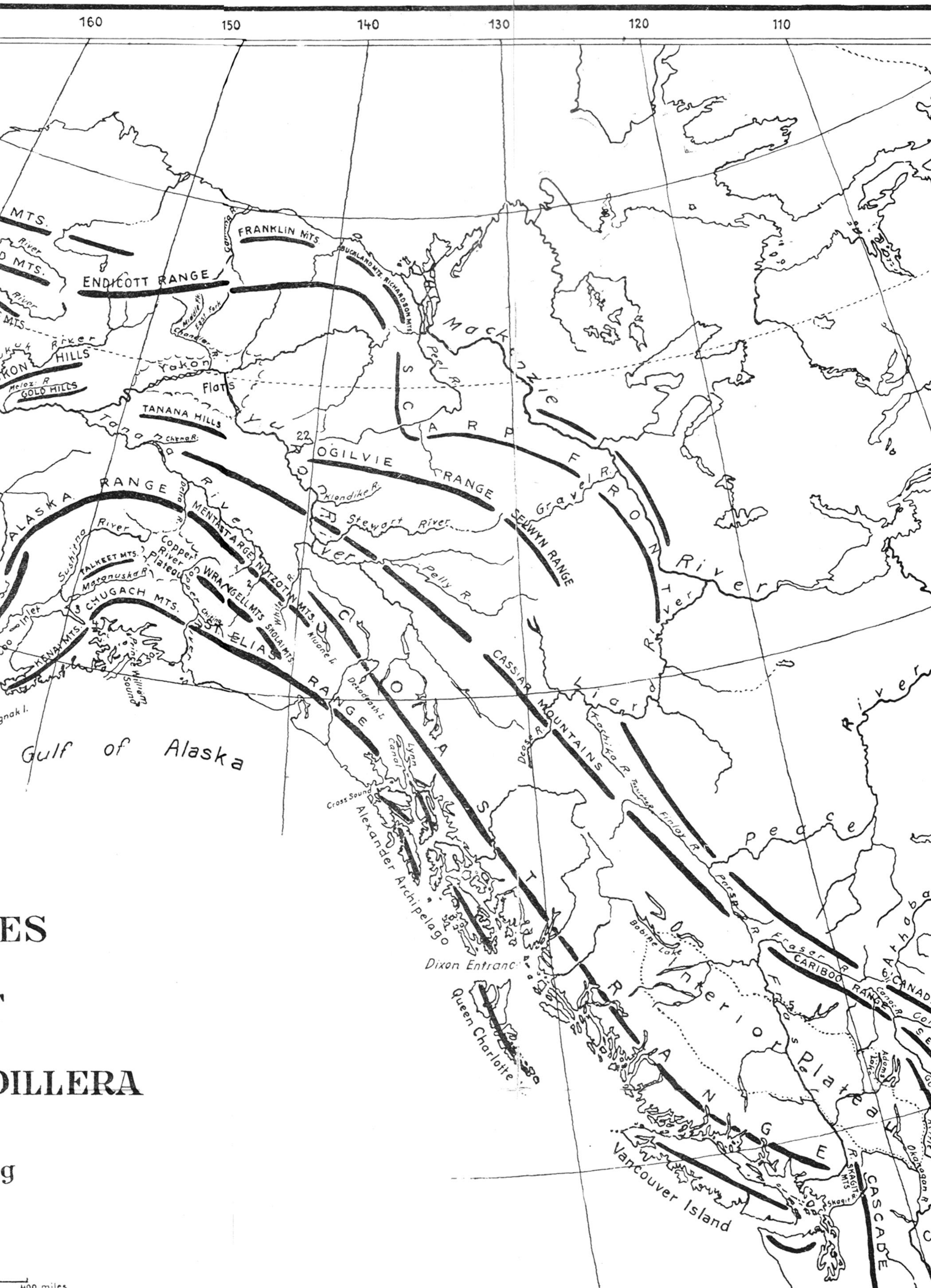
‡ Bitterroot Forest Reserve. Nat'l Geogr. Mag. Vol. IX (1898), p. 391.



THE TECTONIC LINES
OF THE
NORTHERN PART
OF THE
NORTH AMERICAN CORDILLERA

Based on Suess and others
Compiled and drawn by W. Joerg
1910

Scale:

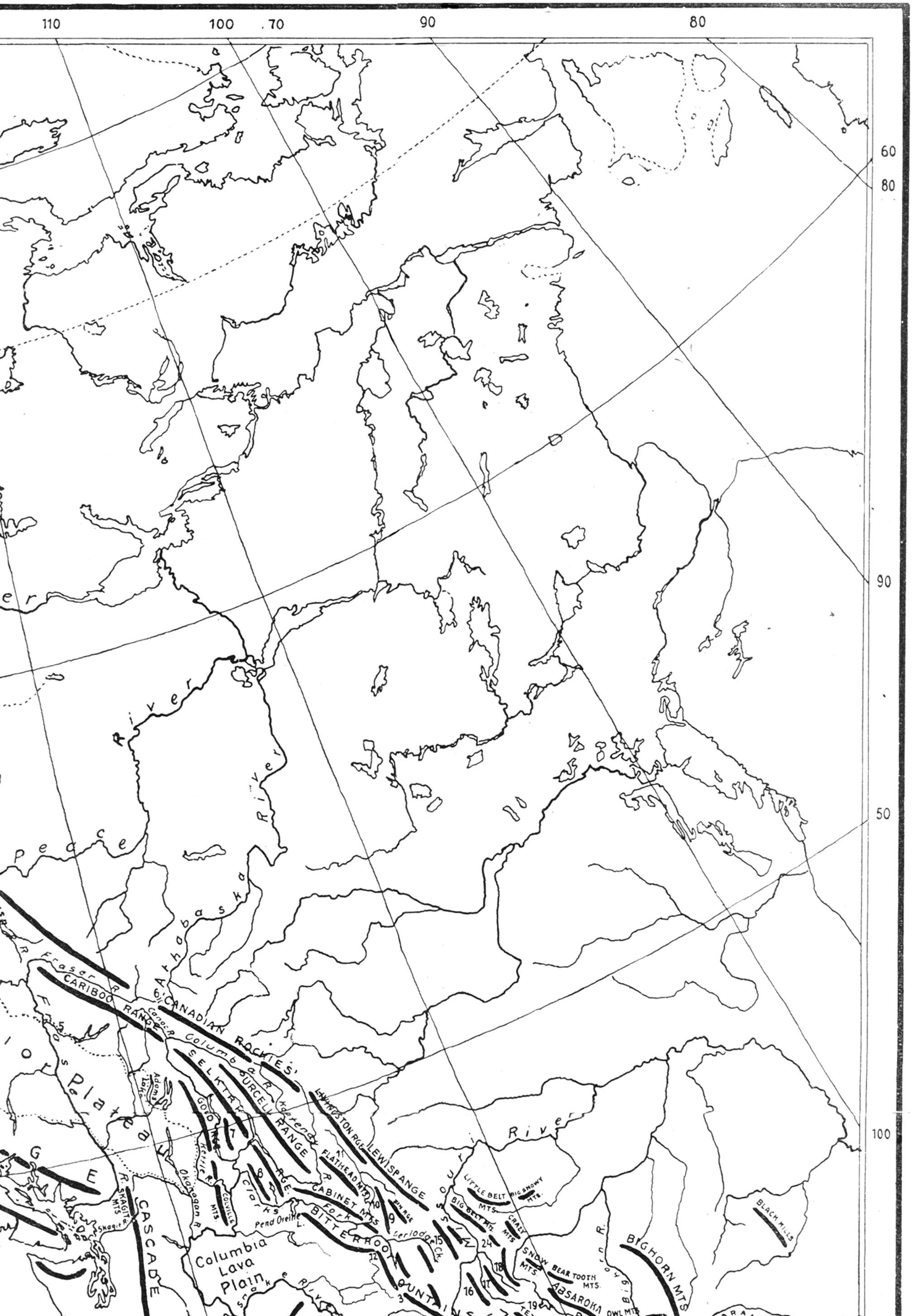


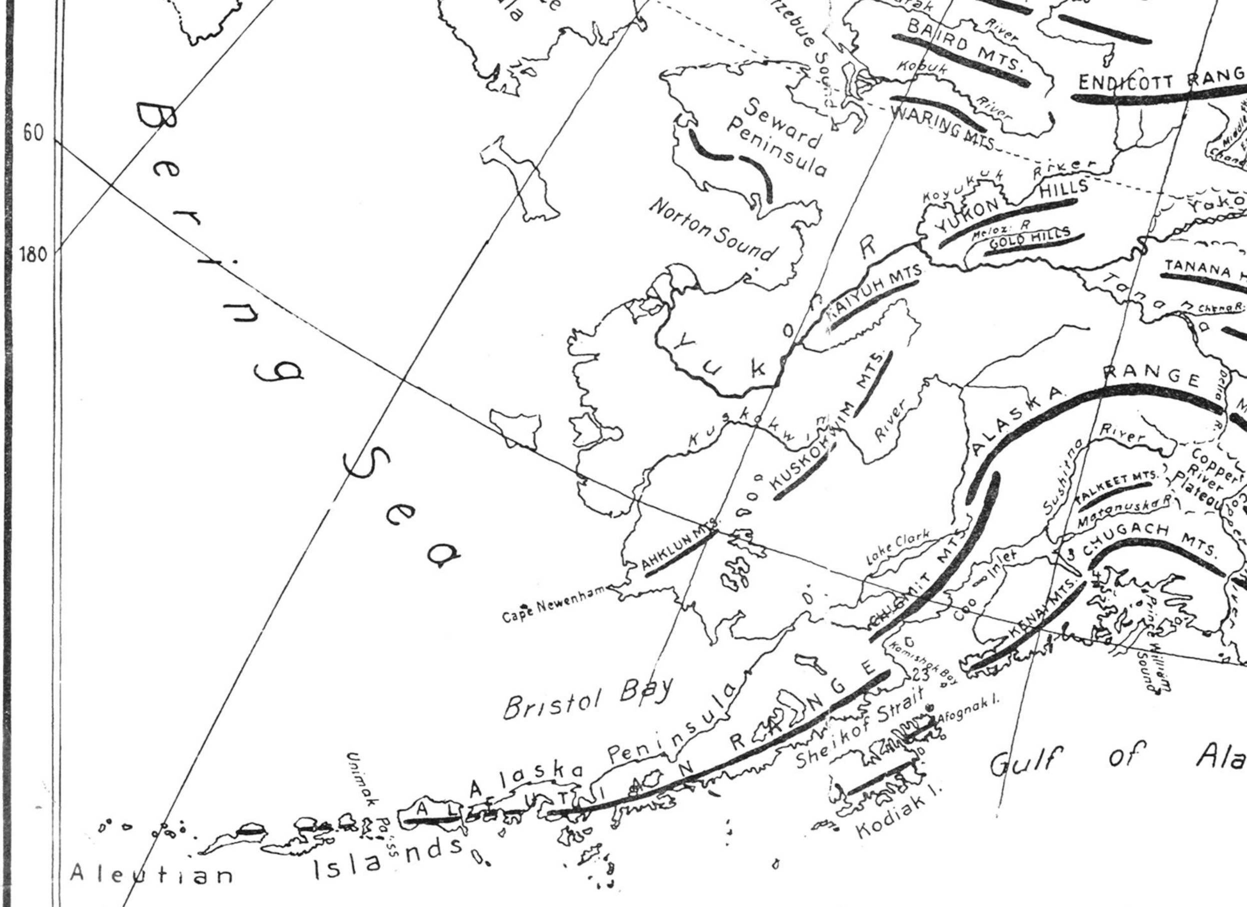
ES

T

DILLERA

g


110
100
70
90
80
60
80
90
50
100
River
River
Peace
Athabaska
Fraser R.
CARIBOO RANGE
Canoe R.
CANADIAN ROCKIES
Columbia R.
SELKIRK
PURCELL RANGE
Kootenay
GOLD RGE
Adams Lake
Plateau
Kettle R.
COLVILLE MTS.
Okanagan R.
Clarks Fork
Pend Oreille L.
CABINET MTS.
FLATHEAD MTS.
LIVINGSTON RGE
LEWIS RANGE
BITTERROOT
Columbia Lava Plain
Snake River
CASCADE
SKAGIT MTS.
Skagit R.
G
E
SOURI
LITTLE BELT MTS.
BIG SNOWY MTS.
BIG BELT MTS.
CRAZY MTS.
SNOW MTS.
BEAR TOOTH MTS.
ABSAROKA
OWL MTS
Bighorn R.
BIGHORN MTS
BLACK HILLS
MOUNTAINS
5
6
7
8
9
10
12
3
15
16
17
18
19
24



THE TECTONIC LINES
OF THE
NORTHERN PART
OF THE
NORTH AMERICAN CORDILLERA

Based on Suess and others
Compiled and drawn by W. Joerg
1910

Scale:

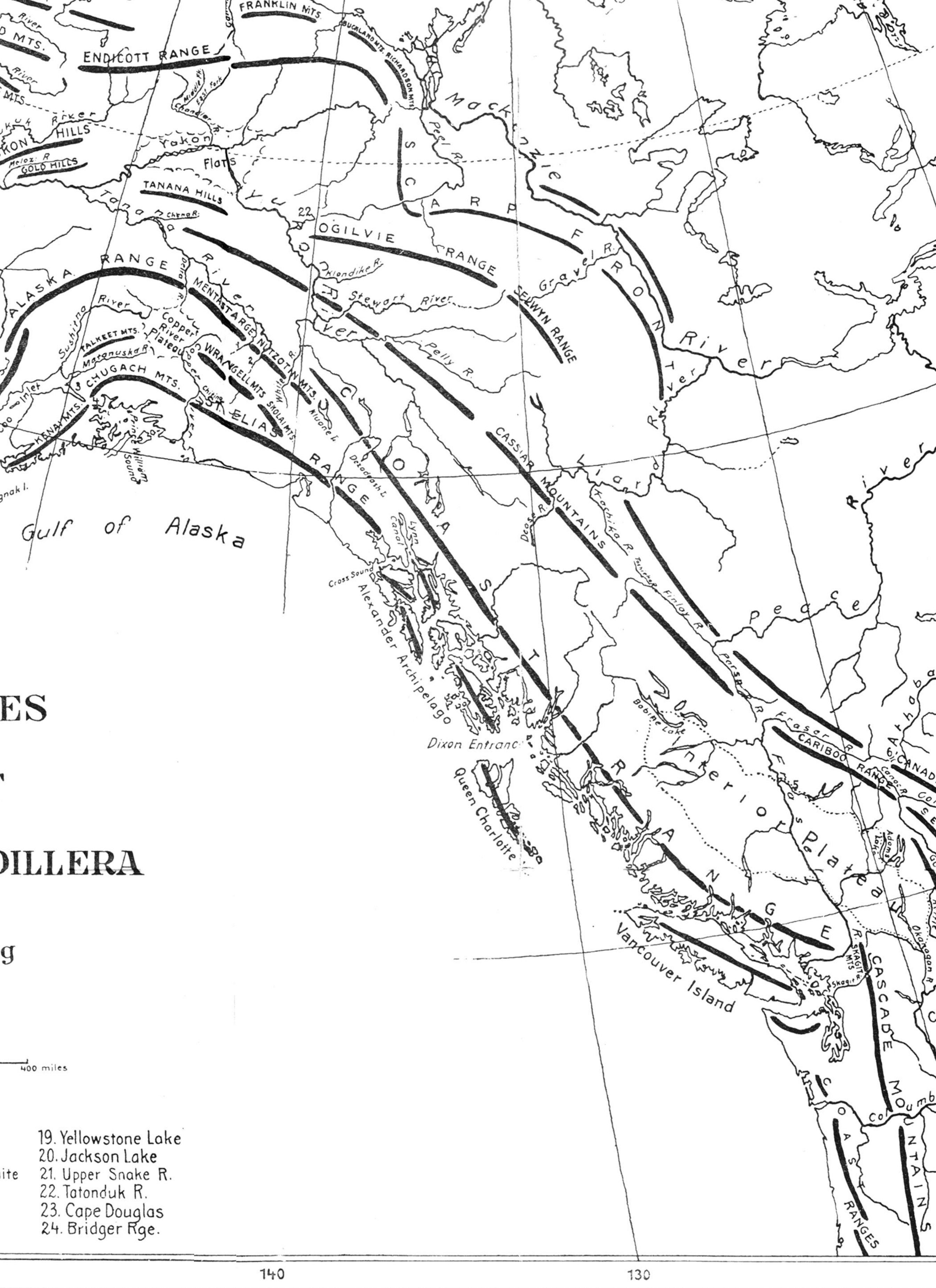
100 0 100 200 300 400 miles

Key to Numerals:

1. Nabesna R.
2. Chisana R.
3. Turnagain Arm
4. Port Wells
5. Quesnel R.
6. Yellowhead Pass
7. Slocan Mts.
8. Pend Oreille Mts.
9. Mission Rge.
10. Flathead Lake
11. Stillwater
12. Lolo Pass
13. Nez Fercé Pass
14. Bitterroot R.
15. Helena-Butte Granite
16. Jefferson Rge.
17. Madison Rge.
18. Gallatin Rge.
19. Yellowstone Lake
20. Jackson Lake
21. Upper Snake R.
22. Tatonduk R.
23. Cape Douglas
24. Bridger Rge.

160 150

Outline traced from Plate 179-180, Andrees Hand-Atlas 1905



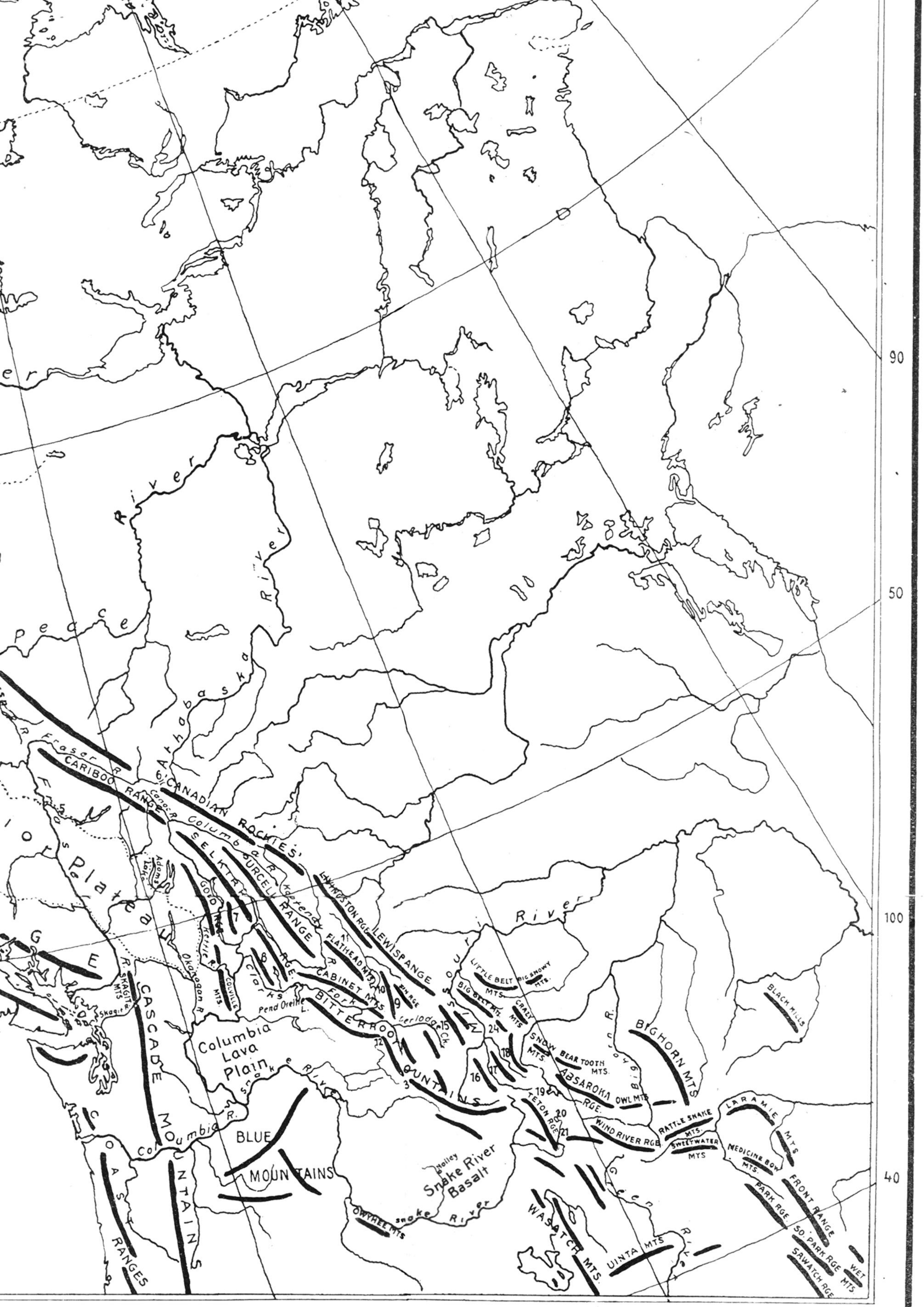
ES

DILLERA

g

ite

19. Yellowstone Lake
20. Jackson Lake
21. Upper Snake R.
22. Tatonduk R.
23. Cape Douglas
24. Bridger Rge.



Lettering by H.V.

Wind River Range trends to the southeast and forks at its eastern end, where its northern branch, the Rattlesnake Mountains, forms the connecting link with the Laramie Range, previously mentioned, and its southern branch, the Sweetwater and Seminole Mountains, with the Medicine Bow Range, already alluded to. These ranges lead over to the mountains of Colorado.

CONCLUSION. REVISION OF THE SUBDIVISION OF THE CORDILLERA. Under the guidance of Suess we have thus obtained a rapid general survey of the North American Cordillera, north of the Gila and the Rio Grande, the unequal character of which is, in part, due to the inequality of our knowledge of the region and in part to limitations set by the present field of investigation of the writer.

In conclusion it seems worth while to reconsider the subdivision of the Cordillera into major geographic provinces, in the light of Suess's work, in order to ascertain whether a modification of the present scheme does not seem advisable. From this point of view the writer would suggest establishing the Alaskides as a separate province, of major rank as a subdivision of the Cordillera. The North American Cordillera, extending from Bering Sea to the Isthmus of Tehuantepec, would, therefore, fall into three major subdivisions: (1) the Northern Cordillera, or the Alaskides; (2) the Central Cordillera; (3) the Southern Cordillera, or Lower California and the Mexican Highland. The boundary between the first and second divisions would be the zone of coalescence, between the second and third the depression previously referred to along Salton Sink, the Gila and the Rio Grande.

The Central Cordillera would be further subdivided into three longitudinal provinces, viz.: (1) the Pacific Mountain System; (2) the Central Plateau Region; (3) the Rocky Mountain System.

In the north the Central Plateau Region would come to a tapering end, enclosed by the Alaska Range Axis and the axis of the inner belt of the Rocky Mountain System coalescing along the upper Tanana River. This delimitation differs from that of Brooks. It seems justified, however, as, even without establishing the Alaskides as a separate province, and even when considering the Central Plateau Region as extended to the west, between the Romanzof and the Alaska Range Axis, this province is so constricted at the point referred to that it naturally resolves itself into two halves. And, finally, the boundary between two opposing forces implied by every coalescence and the decided Asiatic structure of the Alaskides, would seem amply to justify the recognition of the Alaskides as an independent major subdivision of the Cordillera.